KONGERIKET NORGE
The Kingdom of Norway

REC'D 14 SEP 2000
WIPO PCT

PCT/NO 00/00279

4 1/3

Bekreftelse på patentsøknad nr
Certification of patent application no

1999 4094

PRIORITY DOCUMENT
SUBMITTED OR TRANSMITTED IN COMPLIANCE WITH RULE 17.1(a) OR (b)

Det bekreftes herved at vedheftede dokument er nøyaktig utskrift/kopi av ovennevnte søknad, som opprinnelig inngitt 1999.08.24

It is hereby certified that the annexed document is a true copy of the above-mentioned application, as originally filed on 1999.08.24

2000.08.31

Freddy Strømmen

Freddy Strømmen
Seksjonsleder

Ellen B. Olsen

PATENTSTYRET
Styret for det industrielle rettsvern

BL. - 130 - 5000 - 8.98 - Lørenskog Trykk as

1d

24. august 1999
SAS/hv
o:135348

SØKER:
AKER RISER SYSTEMS AS
Boks 1358 Vika
0113 Oslo

OPPFINNERE:
Arne Sele
Haresvingen 10
1362 Hosle

Magne Nygård
Tappen 12
1337 Sandvika

TITTEL:
Stigerørsanordning

FIELD OF INVENTION

The present invention relates to a hybrid riser configuration, primarily for offshore hydrocarbon services, which accommodates relative expansion of the riser tubes and reduces cost and risk exposure.

BACKGROUND

The hybrid riser concept has developed from top tension risers. The principal feature is that it accommodates relative motion between a floating structure and a rigid metal riser by connecting them with flexible jumpers. The first hybrid riser installed, and so far the only, was a single riser anchored to the structure with a tensioned cable. Current concepts mainly involve multiple risers with tension provided by submerged buoyancy anchored by a tether.

The principle advantage of hybrid risers tensioned by submerged buoyancy is that they are not exposed to wave induced cyclic load and are not excited significantly by vessel motion either. The challenge of such designs is to accommodate the relative deformation between the central tether and the risers. The risers are subjected to temperature, internal pressure, and lateral deflection, which give rise to relative deformation.

There is a wide range of solutions accommodating these relative deformations. The most efficient solution will depend on project specific conditions and there may not be one single design solution, which is more cost optimal in all cases. The most attractive solution will be the one minimizing the major cost drivers which are syntactic foam for insulation, flexible flowline connectors, flexible

jumpers, offshore assembly, tow out, and offshore installation

It is envisaged that in the majority of cases the concept using risers with restrained expansion in guide tubes will provide the simplest, most reliable and the more cost efficient solution.

OBJECT OF THE INVENTION

The object of the present invention is to accommodate relative expansion of the riser tubes and reduce cost and risk exposure in connection with fabrication and installation of a hybrid riser configuration.

BRIEF DISCLOSURE OF THE INVENTION

These and other objects are obtained by means of an arrangement characterised in the features mentioned in claim 1.

Further advantages and embodiments are described in claims 2 through 7 and the following disclosure and figures.

BRIEF DESCRIPTION OF THE DRAWINGS

Figure 1 shows a controlled spiral buckling of a steel riser inside a guide tube, 1 being the riser tube and 2 being guide tubes.

Figure 2 illustrates rigid riser and guide tube connections to the base of the hybrid riser construction, 3 being the base and 4 being the risers/tethers

Figure 3 is a section through end connections of a riser tube and guide tube, 5 being corrosion allowance of the aluminium close to the bimetallic interface.

DISCLOSURE OF THE INVENTION

The principal feature of the present invention is how relative expansion of a riser tube 1 is accommodated.

Steel risers 1 are accommodated in aluminium guide tubes 2 which also act as tethers. The tethers 2 are confined by transverse 10 mm thick horizontal plate guides. When restrained, the long and slender risers 1 will buckle inside the guide tubes 2, the buckle occurring in two orthogonal planes with a 90° phase lag forming a spiral. This is illustrated in figure 1.

The top of the riser configuration consists of a soft buoyancy tank, which supports the riser pipe and saddles for flexible pipe jumpers connecting to a vessel. A stress joint is created by stepwise increasing the wall thickness of the tethers. This stress joint is rigidly connected to the tank and the attached pipework.

The same type of stress joint is rigidly connected to the base of the hybrid riser 3, which may be a suction anchor. All risers 1 and guide tubes 2 are rigidly connected to the base 3 and may be extended to the base exterior where rigid pipeline connections can be made. Figure 2 shows the base 3 of the hybrid riser and the riser connections.

The guide tubes 2 are pressurised with nitrogen to prevent implosion occurring due to hydrostatic pressure. Apart from acting as tethers, they also provide the necessary buoyancy for tow out and installation.

The present invention will be fabricated on a roller bed or a rail bed from which it can be launched. A suitable dry dock channel from which it can be floated out is also suitable. The connection to the buoyancy tank and the foundation will be made in connection with the launching. The riser and the buoyancy tank will be made near neutrally buoyant. To achieve this the guide tubes 2 will be used for buoyancy. A clump weight attached to a heave compensator will be provided at the buoyancy tank end. At the foundation end, the suction anchor acts as a clump weight.

The tow out will initially be performed as a near surface tow. In deeper water it may be lowered and completed as a subsurface tow. On location the foundation end will be lowered until the tower is vertical. After releasing the lower end lowering will continue from the top end to allow the foundation to penetrate the mud-line followed by application of suction. When the foundation is in place the buoyancy tank is filled with compressed air

The alternative approach to installation is offshore assembly from a drilling platform. In this case the riser base is initially hung off in a spider on the cellar deck. Tether, riser and conduit pipe sections are then installed with the derrick. It is anticipated that 10 to 12 m sections can be installed at a rate of one per hour.

Aluminium is subject to internal corrosion if CO_2 is present. For this reason the internal tubulars 1 are steel. For oil export at near ambient temperature where the gas fraction is not present, the aluminium tube 2 can act as a riser as well and the internal steel riser tube 1 may be omitted.

The principle of the end fitting is shown in figure 3. Compact flanges of the SPO type will be used. These have a seal system, which allows interfacing of different materials without giving rise to galvanic corrosion or crevice corrosion on the mating faces. The aluminium guide tube tether 2 will act as an anode for the steel end fittings for the flexible jumpers. The exposed area of the steel end fittings will be sufficiently small compared to that of the aluminium tubes 2 that the general corrosion loss will be negligible. Locally on the exposed face of the flange connection close to the bimetallic interface the corrosion loss will be significant. A sufficient corrosion allowance 5 is provided here.

The configuration of the present invention provides a double barrier as well as redundancy in the event of leakage. The principle risk during tow out and installation is, based on historical data, loss of temporary buoyancy. In this instance temporary buoyancy is not required. The buoyancy is provided by the permanent structure. The permanent structure is itself compartamented into a number of risers each consisting of two compartments; the steel riser tube 1 and the annular space between this and the guide tube 2. Both during tow out and installation, and also in service, the flooding of one compartment can be allowed without consequence to the design.

The guide tubes 2 will in the event of failure of the riser tubes 1, provide a second confining barrier.

Advantages according to the present invention are summarized:

- No need of syntactic foam or temporary buoyancy.

- Elimination of flexible riser connections to pipelines at the base.

- Direct pull in of rigid pipelines using field proven sub-sea equipment.

- Elimination of a flexible connection to the central tether at the base as well as elimination of the central tether itself using the guide tubes 2 to take the tether force.

- Tow out and installation in one operation, or alternatively from a spider on a drilling platform

- No partial offshore assembly.

- Hot water may be circulated through guide tubes to heat risers.

CLAIMS

1. Hybrid riser configuration comprising a plurality of riser tubes (1) substantially inserted in guide tubes (2), with buoyancy means and tension means, the guide tubes (2) being pressurised and the riser tubes (1) and guide tubes (2) being connected to a base (3) anchored to the ocean floor,
c h a r a c t e r i s e d i n that there are a plurality of guide tubes (2) of conduit type acting as multiple tethers allowing restricted, buckled deformation of a riser tube (1) inserted in a guide tube (2), or allowing the guide tube (2) itself to act as a riser tube, omitting the inserted, internal riser tube (1).

2. Hybrid riser configuration according to claim 1,
c h a r a c t e r i s e d i n that the riser tubes (1) and guide tubes (2) are rigidly connected to the base (3) of the riser configuration.

3. Hybrid riser configuration according to claim 1 or 2,
c h a r a c t e r i s e d i n that the guide tubes (2) comprises aluminium, an aluminium, or a similar light metal.

4. Hybrid riser configuration according to any of the preceding claims,
c h a r a c t e r i s e d i n that the guide tubes (2) act as sacrificial anodes.

5. Hybrid riser configuration according to any of the preceding claims,
c h a r a c t e r i s e d i n that upon tow out and installation, the guide tubes (2) provide necessary buoyancy to make the riser configuration near neutrally buoyant, an attached anchoring means acting as a clump weight.

Abstract

Hybrid riser configuration comprising a plurality of riser tubes (1) substantially inserted in guide tubes (2), with buoyancy means and tension means, the guide tubes (2) being pressurised and the riser tubes (1) and guide tubes (2) being connected to a base (3) anchored to the ocean floor.

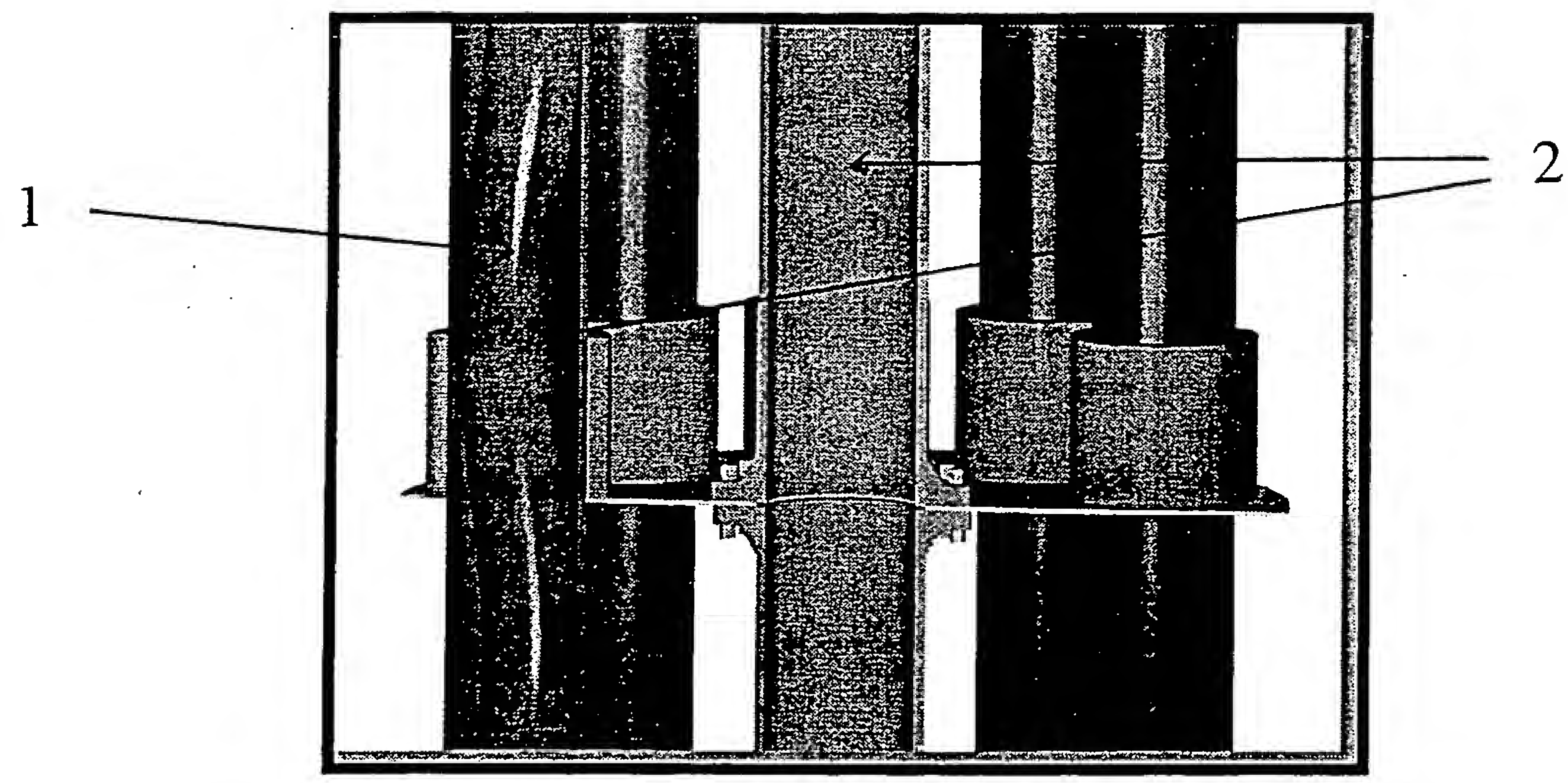

Figure 1

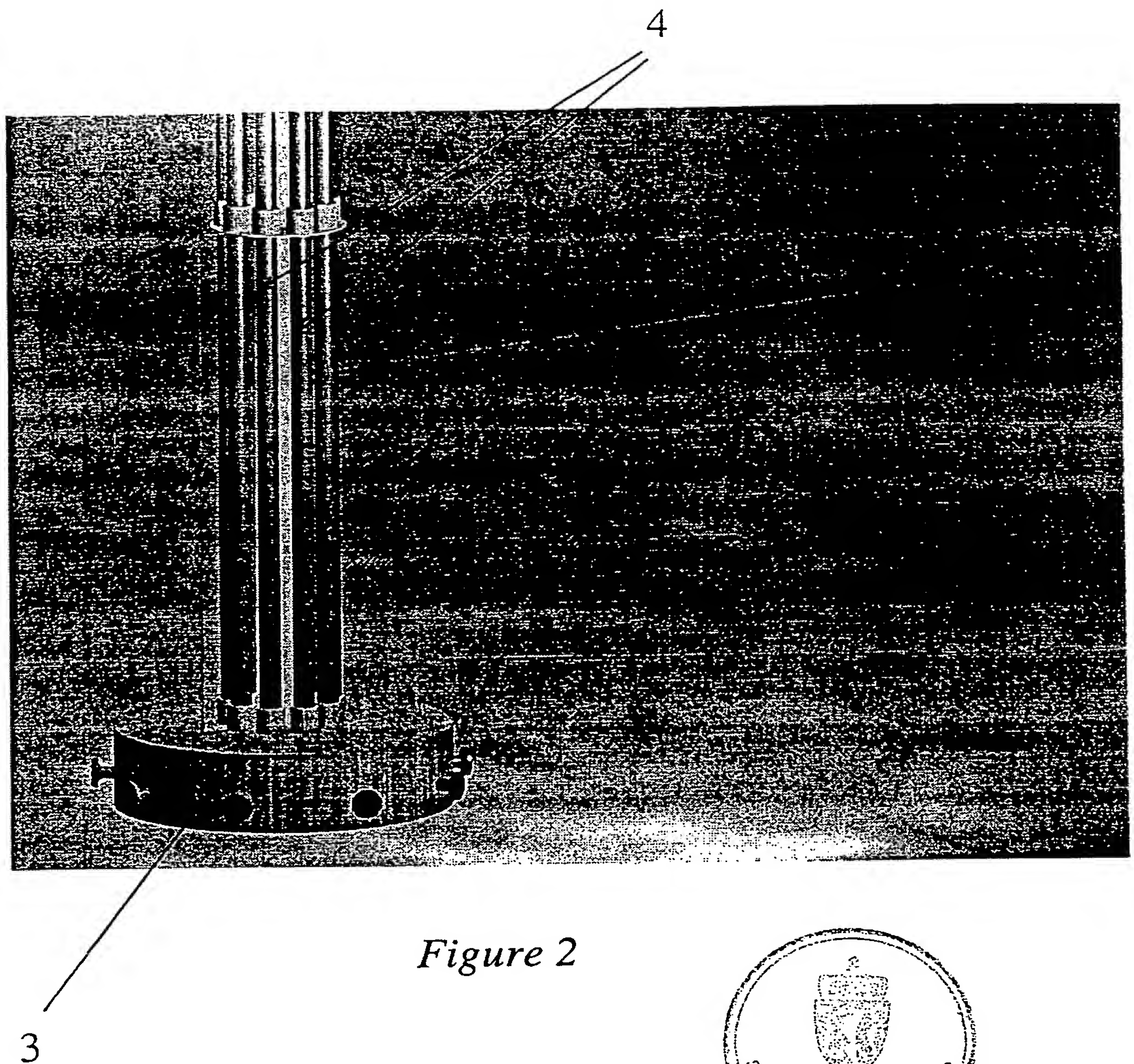

Figure 2

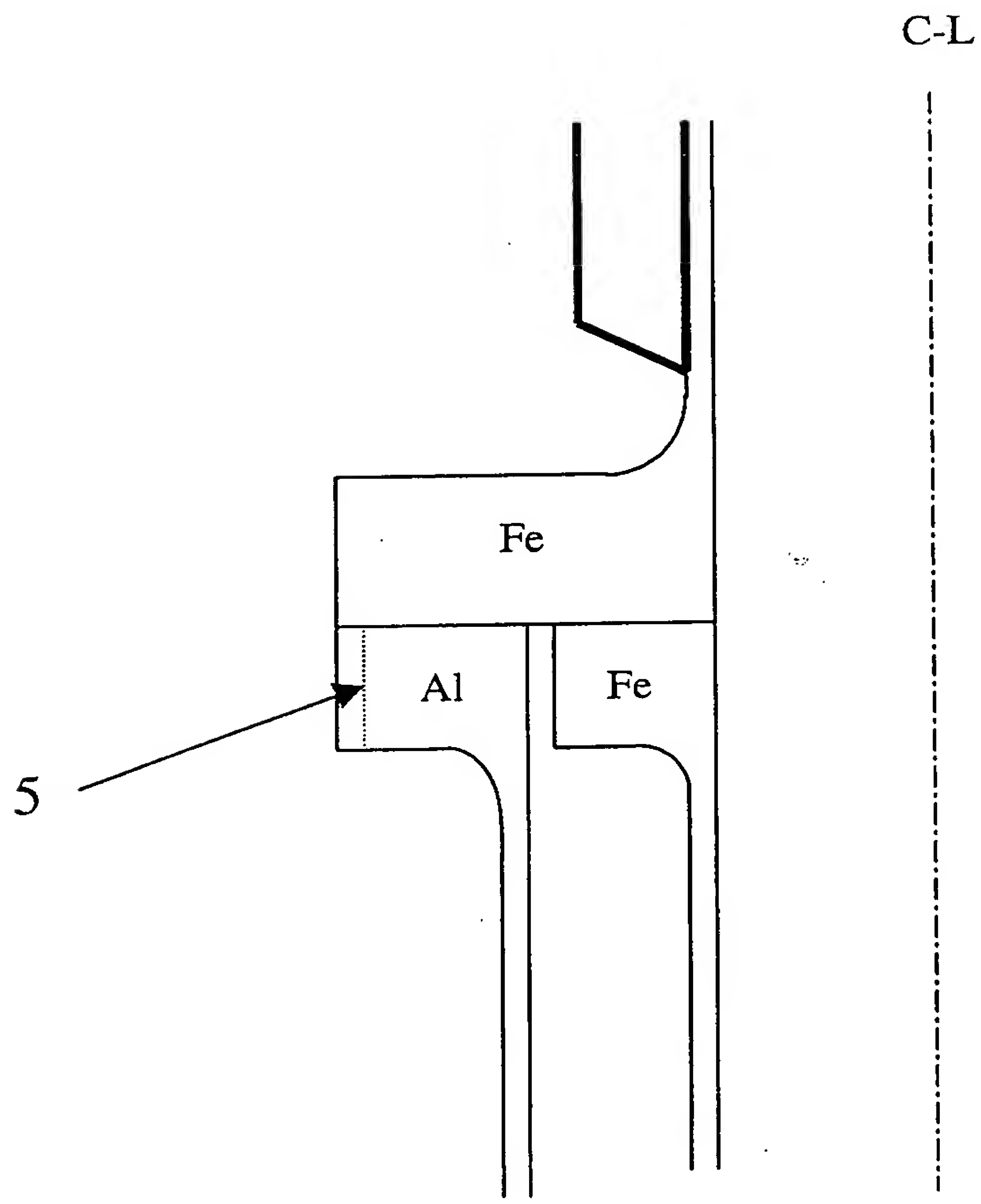

Figure 3